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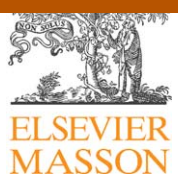

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ORIGINAL ARTICLE

Arthroscopic treatment of discoid meniscus in children: Clinical and MRI results

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Summary
Introduction: Treatment of symptomatic discoid meniscus in children is saucerization performed under arthroscopy. The strategy to adopt for associated meniscus lesions is discussed, from partial meniscectomy to meniscal repair. The latter was applied in the series studied herein. The objective was to assess this surgical strategy.
Patients: This was a retrospective study of 20 discoid menisci (18 patients) operated between 2004 and 2007.
Method: The patients first underwent arthroscopic saucerization and then, a procedure that depended on the residual meniscus: no additional procedure if there was no lesion, suturing or reinsertion in cases with a repairable lesion, and partial meniscectomy in cases of a non repairable lesion. All patients were assessed clinically and with postoperative MRI.
Results: The mean follow-up was 37 months. Five discoid menisci presented no lesion and were treated with isolated saucerization. Fifteen discoid menisci presented a lesion. In four cases, saucerization removed this lesion. In eight cases, we performed meniscal repair after saucerization. In three cases, partial meniscectomy was necessary. The Lysholm score ranged from 67 to 88. Sixteen patients were satisfied or very satisfied in 16 cases. The mean Tegner score was 5.9. Postoperative MRI showed no signs of chondral degeneration. The mean measurements of the residual meniscus corresponded to the guidelines. Patients having undergone saucerization associated with meniscal repair had better results than those who had partial meniscectomy or meniscus repair alone ($P = 0.007$, Fisher test).
Discussion: No other study having evaluated discoid meniscus surgery with postoperative MRI has been reported and few studies have been published on saucerization associated with repair. This approach spares the meniscus, as confirmed by MRI, with the size of the residual meniscus within the guidelines. We obtained good clinical and anatomic results, with good healing of the meniscus and satisfactory measurements.
Level of evidence: Level III. Retrospective study.

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Introduction

Discoid meniscus is a relatively rare congenital anatomical abnormality of the lateral meniscus, described for the first time by Young in 1889 [1]. Its incidence varies, depending on the published series, from 0.4 to 16.6% of the population, with identical distribution between males and females [2—4]. Its prevalence varies according to race: from 5% in Caucasians [5] to 16.6% in the Japanese [3]. The most recent etiopathogenic theories tend toward an etiology of malformation, congenital, in a context of regional femorotibial dysplasia [6,7]. Watanabe et al. [8] classify discoid meniscus into three types according to the arthroscopic aspect: type I for complete discoid meniscus, type II for incomplete discoid meniscus, and type III for unstable discoid meniscus caused by absence of the posterior meniscotibial ligament (Wrisberg-ligament type).

Discoid meniscus is often revealed clinically during childhood. However, many children with discoid meniscus remain asymptomatic and therefore require no treatment [9—12]. Only for symptomatic discoid meniscus is surgery indicated [13], with the objectives of removing symptoms and preventing meniscal degeneration so as to increase the chances of preserving the meniscus [14].

The discoid meniscus is a dysplastic meniscus, more fragile than a normal meniscus, which explains the frequency of meniscal lesions found in the literature (40—80%) [10,11,13,15—17].

Treatment is arthroscopic saucerization, i.e., resection of the central portion of the discoid meniscus, aiming to give this meniscus a shape approaching normal [16,18,19]. In cases of persistent lesion after this saucerization, partial meniscectomy removing the lesion is necessary [10,20].

In children, sparing the meniscus is an important concept to consider. Indeed, post-meniscectomy joint growth in children is fraught with the premature appearance of radiological signs of degeneration [21—23], particularly in cases of lateral meniscectomy [20,24]. Furthermore, for several authors, meniscus healing is directly related to the quality of its vascularization [25,26]. Yet, children have better meniscal tissue vascularization than adults [27]. These two arguments should encourage one to spare the meniscus and repair the lesioned meniscus in children [28,29], explaining why some authors suggest, in cases of persistent lesion after saucerization, meniscal suturing [3,11,30—32]. This was applied in the present series.

The objective of this study was to assess the results of this surgical strategy, both clinically and anatomically, using systematic MRI.

Patients and methods

This was a retrospective study on a continuous series of 20 discoid menisci (18 children) operated between 2004 and 2007. All patients were operated on by the same surgeon. Twelve of the children were female and six were male. The mean age of the patients at diagnosis was 9 years (range, 5—13 years). All presented symptomatic discoid meniscus.

The main motive for consultation was pain in 10 cases, clunking in five cases, associations of pain and locking in four cases, and isolated locking in one case. The clinical exam most often found clunking in seven cases, loss of extension in five cases, and positive meniscal tests in another five cases (Table 1).

Figure 1 Preoperative MRI in a 9-year-old girl.

All patients had a preoperative MRI, which confirmed the diagnosis (Fig. 1).

The discoid meniscus was classified intraoperatively using the Watanabe classification. Any lesions were noted as was the presence of any cartilaginous lesions.

The first procedure was saucerization, consisting of centrifugal resection to obtain a meniscus approaching a normal shape. Then, the residual meniscus was assessed. In cases of unstable (type III) meniscus, it was sutured to the peripheral structures (capsule and/or popliteal tendon through the popliteal hiatus). In cases of repairable meniscal lesion, the lesion was sutured. In cases with a non repairable lesion, a partial meniscectomy removing the lesioned zone was performed.

Suturing was done using all inside techniques: Rapid Lock™ [Mitek] or Fast Fix™ [Smith and Nephew] implants. The decision between repair and partial meniscectomy was based on the intraoperative aspect of the persistent lesion. The meniscus was repaired when a lesion was accessible to repair, whether it was in the red-red zone or the red-white zone, or even the white-white zone. The main criterion was the presence of healthy meniscal tissue. In the other cases, partial meniscectomy was performed.

Postoperative care differed depending on the surgery performed: in cases of isolated saucerization, a simple knee brace for 10 days with partial weightbearing; in cases of saucerization associated with partial meniscectomy, a simple knee brace was prescribed for 3 weeks with partial weightbearing; in cases of saucerization associated with repair, a fiberglass long-leg cast for 45 days, with no weightbearing allowed. Weightbearing was authorized as the leg was progressively mobilized. Physical therapy was never prescribed.

The patients were reviewed at a mean 37 months (range, 14—57 months). They were assessed clinically, which included a study of knee range of motion, Lysholm and Tegner scores, return to previous physical activity, and satisfaction. All the patients had a postoperative MRI at a mean 28 months (range, 6—54 months) after the intervention, to evaluate the measurements of residual meniscus and meniscal healing (Fig. 2).

A statistical study (Fisher exact test) was performed so as to compare the results between saucerization alone, saucerization and repair, and saucerization and resection.

Results

According to the Watanabe classification, eight menisci were type I, nine type II, and three type III. Intraoperative meniscus assessment found no lesions in the meniscus in five cases and one lesion in 15 cases: a longitudinal lesion in eight cases (five of which were bucket handle lesions), a horizontal lesion in three cases, a radial lesion in one case, and a complex lesion in three cases (Table 1).

In five cases of discoid meniscus with no lesion, only saucerization was performed. In the 15 cases of discoid meniscus with a lesion, the first surgical procedure per-

Table 1 Initial clinical exam, meniscus workup, and surgical procedure.

Case	Age/gender	Reason for consultation	Clinical exam	Watanabe type	Preoperative meniscal lesion	Surgical procedure
1	10/M	Pain	Positive meniscus tests	1	Complex	Saucerization, transversal and vertical suture rupture
2	12/F	Pain	Positive meniscus tests	2	Longitudinal	Saucerization
3	8/M	Pain	Clunking, positive meniscus tests	2	Complex	Saucerization, anterior horn suturing
4	10/F	Pain, effusion, clunking	Effusion	2	Complex	Partial meniscectomy
5	12/M	Pain, locking	Normal	2	Longitudinal	Saucerization
6	9/M	Clunking	Clunking	2	Longitudinal (bucket handle)	Saucerization, anterior horn suturing
7	11/F	Locking	Locking	2	None	Saucerization
8	9/F	Pain, locking	Loss of extension, effusion	1	Radial	Partial meniscectomy
9	6/M	Clunking	Clunking	3	Longitudinal (bucket handle)	Saucerization, reinsertion bucket handle
10, right	12/F	Clunking	Loss of extension, clunking	2	Longitudinal (bucket handle)	Saucerization
11, left	12/F	Clunking	Loss of extension, clunking	2	Longitudinal (bucket handle)	Saucerization
12, left	9/M	Pain, loss of extension	Loss of extension	3	Longitudinal	Saucerization, posterior horn reinsertion
13, left	9/M	Pain, locking	Normal	1	Longitudinal (bucket handle)	Saucerization, bucket handle reinsertion
14	10/F	Pain	Normal	1	Horizontal	Saucerization
15	11/F	Clunking	Clunking	1	Horizontal	Partial meniscectomy
16	10/F	Loss of extension	Loss of extension	1	Horizontal	Saucerization
17	12/F	Pain	Positive meniscus tests	1	None	Saucerization
18	13/F	Pain, effusion, locking	Loss of extension	1	None	Saucerization
19	6/F	Pain, loss of extension	Loss of extension, positive meniscus tests, clunking	2	None	Saucerization
20	11/F	Pain	Normal	3	None	Saucerization, anterior and posterior horn reinsertion. 5 transchondral perforations

Figure 2 MRI 2 years after surgery.

formed was always saucerization. This removed the lesion and, therefore, was sufficient in four cases. In eight cases, a repairable lesion remained after saucerization, which was repaired (three cases of peripheral tear, six meniscal lesions, one association of meniscal lesion with peripheral tear). In three cases, there was a non repairable lesion for which a partial meniscectomy was performed. No total meniscectomies were performed (Table 1).

We noted one case of an association with osteochondritis of the lateral femoral condyle, International Cartilage Repair Society stage 2. After treatment of the discoid meniscus, five transchondral perforations were made with a 1.5-mm pin.

From the clinical point of view, the Lysholm score always improved, from 67 (range, 41—90) preoperatively to 88 (range, 55—100) at follow-up. The score was good or excellent (range, 84—100) in 15 cases and fair (range, 65—83) in four cases. Only one case had a poor score (<65), in a child who had developed osteochondritis of the ipsilateral femoral condyle 3 years after the surgical intervention.

In 16 cases out of 18, the patients were satisfied or very satisfied. The functional status had improved, as shown by the number of patients who returned to their previous physical activities (14 cases out of 18) and the mean Tegner score of 5.9 (range, 3—7). Knee range of movement always returned to normal (Table 2).

MRI showed absence of signs of chondral degeneration. Six cases showed an intrameniscal hypersignal (Fig. 3). We noted one case of recurrence of meniscal rupture. The dif-

Table 2 Postoperative clinical assessment and MRI.

Case	Lysholm score		Tegner score	Return to previous physical activity	Satisfaction	Postoperative MRI	
	Preop	Postop				Measurments in mm	Comments
1	63	90	6	Yes	Very satisfied	2.1 × 2.1/1.9 × 1./10.7 × 2.1	
2	71	80	6	Yes	Very satisfied	5 × 2/3 × 2/5.5 × 3.5	Hypersignal
3	72	100	7	Yes	Very satisfied	7 × 1/8 × 4/10 × 4	Hypersignal
4	63	81	3	No	Satisfied	11 × 4/5 × 4/7 × 4	
5	68	75	6	Yes	Satisfied	6.6 × 1.9/13.8 × 2.4/5.5 × 2.2	
6	63	99	7	Yes	Very satisfied	2.1 × 2.1/1.9 × 1.5/10.7 × 2.1	
7	59	89	6	Yes	Very satisfied	6.7 × 1.8/9.1 × 2.16/6 × 2	Hypersignal
8	41	82	6	No	Fairly satisfied	10 × 4.4/3 × 1/8.7 × 3.7	
9	80	91	7	Yes	Very satisfied	6.2 × 3.5/?? × 3.5/8.7 × 3.5	
10, right	82	100	6	Yes	Very satisfied	5 × 2/3 × 2/5.5 × 3.5	
11, left	59	100	6	Yes	Very satisfied	7 × 1/8 × 4/10 × 4	
12, right	63	95	6	Yes	Satisfied	7.2 × 2.7/4.5 × 1.8/5.4 × 1.8	Hypersignal
13, left	63	90	6	Yes	Satisfied	11.2 × 1.5/0.7 × 0.7/3 × 0.9	Recurrence of tear
14	59	90	7	Yes	Very satisfied	17.7 × 2.7/1.4 × 0.7/11.6 × 3.4	
15	86	77	4	No	Satisfied	11 × 4/5 × 4/7 × 4	
16	90	99	6	Yes	Satisfied	6.7 × 1.8/9.1 × 2.16/6 × 2	Hypersignal
17	71	85	6	Yes	Satisfied	7.2 × 2.7/4.5 × 1.8/5.4 × 1.8	
18	59	80	6	Yes	Satisfied	7.1 × 2.4/10.7 × 2.4/13.1 × 3.6	
19	63	55	4	No	Fairly satisfied	6 × 3/10 × 2.5/7 × 3	Osteochondritis external condyle
20	63	100	7	Yes	Very satisfied	11 × 4/5 × 4/7 × 4	Hypersignal

Figure 3 Example of hypersignal on postoperative MRI.

ferent segments of the residual meniscus were measured. For the anterior segment, these measurements were a mean 8.6-mm wide and 2.6-mm high; for the middle segment, they were 5.5 mm wide and 2.3 mm high, and for the posterior segment, 5.8 mm wide and 3.0 mm high (Table 2). These measurements were identical to what is recommended in the literature after saucerization, i.e., between 4 and 8 mm [18,33,34].

The statistical analysis sought to identify a relation between surgical technique and clinical status. The Fisher exact test demonstrated a significant difference ($P = 0.007$) with patients who had undergone saucerization associated with suturing having better results than those who had undergone saucerization alone or saucerization associated with partial meniscectomy (Table 3). Relations between a hypersignal on postoperative MRI and surgical technique and between a hypersignal and clinical status were also sought. However, in both cases no significant difference was found ($P = 0.818$ and $P = 1.000$, respectively, according to the Fisher exact test).

No infectious complication was found.

Three cases were problematic. The first was a case of osteochondritis of the ipsilateral femoral condyle, 3 years after surgery, the only patient with a poor Lysholm score. These cases of post-meniscectomy osteochondritis usually regress spontaneously [14]. The second case was a girl who presented a discoid meniscus with a longitudinal lesion. The intervention consisted in saucerization alone. Three years after surgery, a sports injury in the knee caused a complex lesion of the anterior and middle segments, requiring partial meniscectomy. At 20 months, the Lysholm score was 80. The third case was in a boy who initially presented a discoid meniscus with bucket handle tear. During surgery, this bucket handle was found to be retracted, fixed, appearing to be old. We nevertheless performed a reinsertion of this bucket handle. One year after surgery, he presented a new dislocation of this bucket handle, requiring partial meniscectomy. This may be an excessive indication of repair. At 14 months, this patient presented a Lysholm score of 90.

Discussion

In the past, total meniscectomy was widely indicated in the treatment of discoid meniscus [20,35]. Then, several articles showed the advantages of arthroscopic saucerization [18,36]. In cases of meniscal tear after saucerization, many systematically performed partial meniscectomy removing this tear, with often substantial loss of meniscal tissue. Yet, when this tear is repairable, one can combine saucerization followed by repair. This saucerization—repair combination was first described not for meniscus tear but for hypermobile meniscus or type III meniscus in the Watanabe classification (Wrisberg type). In 1981, Ikeuchi was the first to describe this technique [3], used with three patients, but without long-term results. Rosenberg et al. reported a case of this technique with a good clinical result at 1 year [31]. Neuschwander et al. reported that four out of six patients who had undergone repair under arthroscopic control for peripheral meniscal tear presented an excellent result [32]. More recently, Adachi et al. described five cases of a lesion with discoid meniscus treated with saucerization and repair of these lesions. These five cases showed a good clinical result, four of which were excellent after more than 2 years of follow-up [11]. In 23 patients (28 knees) treated with saucerization and meniscal repair, Ahn et al. observed 21 excellent results with a mean follow-up of 51 months [30].

The series analyzing saucerization associated with repair are rare. They all report a small number of cases, except for Ahn et al. [30]. The present study confirms the good results with this technique.

We observed a significant influence of the type of surgical procedure on the clinical result. In this study,

Table 3

Clinical	Saucerization alone	Saucerization + meniscectomy	Saucerization + repair	Total
Good/excellent	5	0	8	13
Poor	1	0	0	1
Fair	3	3	0	6
Total	9	3	8	20

Fisher's exact test, $P = 0.007$.

therefore, the patients who had undergone saucerization associated with suturing had better results than those who had had saucerization associated with partial meniscectomy. One could hypothesize that the beneficial effect of longer immobilization in children with suturing explains this (immobilization-related stiffness is not an issue in this population).

Moreover, to respect the concept of sparing the meniscus and preventing progression to osteoarthritis over the longer term with meniscectomy [21—23], it is best to be as conservative as possible and prefer meniscus repair.

This is the only study to have evaluated discoid meniscus surgery with systematic postoperative MRI. We choose to assess our results using this imaging technique because it is non invasive. The MRI results confirmed our good clinical results, i.e., good radiological meniscus healing and meniscus measurements corresponding to the recommendations in the literature [18,33,34]. In six cases, we found a hypersignal probably related to the healing process. No relation between the hypersignal and the surgery used was demonstrated, nor between the hypersignal and the clinical status.

The limits of this study are related to its retrospective nature and the limited follow-up. Even if satisfactory function can now be envisioned, several years will be necessary before final conclusions can be drawn.

Conclusion

The surgical strategy consisting in first saucerization and then meniscal repair as needed provides good clinical and anatomical results over the short-term and makes it possible to spare the meniscus. These encouraging results still require long-term confirmation.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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